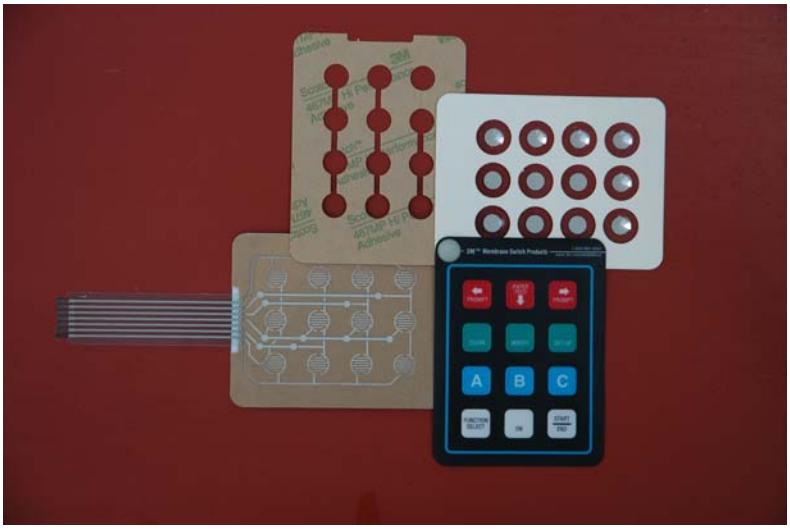
HOLLAND 1916

PROGRESSIVE PRODUCT SOLUTIONS

Membrane Switch Design Guide



Introduction

Membrane switch technology has become a reliable front panel solution where environmental concerns or frequent cleaning are an issue. The sealed nature of the technology coupled with its reliability and ability to offer tremendous aesthetic flexibility make it the solution of choice for many industries.

The success of any membrane switch design effort is greatly enhanced by effective communication between the design engineers and the membrane switch vendor. A mutual understanding of the technology and nomenclature is critical. This design guide is a tool to facilitate communicating those requirements.

Overlay Materials

A variety of overlay materials are used in membrane switch applications. Polycarbonate is a commonly used material because it is easy to print on, die cut and emboss – making it a very cost effective alternative. The disadvantage of polycarbonate is that it begins to show signs of wear sooner than some of the alternate materials. In most applications polycarbonate overlays will last a minimum of 100,000 cycles during life cycle testing. Uncoated polycarbonate is also susceptible to damage from a variety of chemicals. If a polycarbonate overlay is going to be in an environment that will subject it to chemicals, a hardcoat should be used to protect the overlay.

Polyester is a more robust material that has superior life cycle and chemical resistance properties. In life cycle testing, polyester shows no signs of wear at 1,000,000 cycles. However, polyester, due to its memory properties, frequently requires hydroforming rather than embossing. Hydroforming is more expensive for both tooling and unit cost. Polyester is also more difficult to die cut resulting in more frequent reblading of steel rule dies.

Both polyester and polycarbonate are available with a variety of textures and hardcoats. In their uncoated glossy form both materials are very susceptible to scratching. For this reason we recommend that gloss materials receive a hardcoat.

Material suppliers have developed specialty materials that offer some or all of the properties mentioned above. Appendix “A” lists many of the commonly requested specialty materials. For additional technical data or specific applications, please contact your Holland Nameplate sales engineer.

Artwork

Holland Nameplate offers complete artwork layout services. The customer should

specify type styles, colors, and sizes of all copy. Artwork should be provided to us for all logos or special symbols. We use the latest version of Autocad with Autoscript to generate our drawings and artwork. It is helpful for customers to supply us with an Autocad DWG file, or as an alternate, a DXF or IGES file. Always provide Holland Nameplate with a hard copy drawing as well. Proofs of the artwork will be sent for approval to our customer prior to production.

Color Matching

There are many systems that a customer can use to communicate color requirements to us.

Pantone® Matching System (PMS) is the most popular color standard. It identifies colors by specific numbers. This system was originally devised for use in the offset printing industry, but has become a common tool for all types of printing. The Pantone System is very popular because it is inexpensive and simple to use. There are over 1000 colors displayed in a Pantone color guide that can be purchased for about $75.00. The disadvantage of this system is that there are slight variations in the colors from sample book to sample book. The colors also fade with time, and books need to be replaced annually. These samples are printed with offset inks on white paper, and therefore we may not be able to exactly match a color by screen printing or painting on a particular substrate.

The Munsell Color System identifies colors in terms of three attributes: hue, value, and chroma. The physical samples to which we match using this system are opaque, pigmented films. There are over 1500 Munsell color samples available. Holland Nameplate's files contain many, but not all, of these color samples. We are able to order samples for colors we do not have on file.

CIE (International Committee on Illumination) The CIELAB color system is the most widely recognized system for describing colors with numbers. The advantage of using a numeric system is that it is objective, and computers can be used to match colors and quantify how close a color match is. We require a physical color chip (2" x 2" minimum) as well as the numeric color coordinates to match a color using this system.

Customer supplied color samples: We can match the color of a customer - supplied sample if required. Our preference is that the sample be at least 2" x 2" on painted metal. The sample should also be opaque. It should be kept in mind that colors will appear different when printed on different substrates. This is especially true in the case of subsurface printing on membrane switch overlays.

Color samples are supplied to customers when requested. We supply a sample of the actual ink to be used in production applied to the same substrate from which the part will be made. We provide this service at no charge in conjunction with an order.

Ultraviolet Hardcoats

The most durable hardcoats are those that are cured by exposure to ultraviolet light. These coatings are called UV hard-coats. Hardcoats can be selectively added to many of the materials to produce parts with a velvet textured background, and gloss or anti-glare windows.

Embossing

In many applications it is desirable to emboss or hydroform the keys of a switch. The phrase “Plateau Embossing” is used to describe keys that are raised and flat on the top. The term “Rim Embossing” is used to describe raising only the border of a key. Embossing is typically .010" high and two dimensional.

Hydroforming can be used to attain higher embossments, up to 2-3 times material thickness. Three dimensional dies can also be built. Overlays can be hydroformed with domes in them to provide tactile feedback. Hydroforming tools are significantly more expensive than embossing tools.

We have samples of both hydroforming and embossing on polyester and polycarbonate that will help illustrate the different results that can be attained. Contact a Holland Nameplate sales engineer to request hydroforming and embossing samples.

Cosmetic Inspection

In evaluating the cosmetic attributes of a membrane switch, it is important that the vendor and the customer have a common understanding of how the part will be inspected, and what the criteria for evaluation will be. To facilitate this Holland Nameplate has developed a standard cosmetic inspection specification. In the absence of a customer specification we will use this standard.

This standard is also useful in setting a standard format for specifying cosmetic inspection requirements. It is recommended that in cases where the customer desires to establish his own inspection criteria, the format of our specification be used.

The key requirements include viewing time, viewing angle, viewing distance, and defect size.

Mechanical Tolerances

Steel rule dies are usually used to fabricate the various layers of a membrane

switch. Standard tolerances should be +/- .015". Tolerances of +/- .010" can be held on critical dimensions such as the perimeter or cutouts. Hole center to hole center tolerances of +/- .005" can be held. Tolerances on very large parts will be greater. Tighter tolerances can be held by laser cutting or with the use of hard tooling.

The switch layers under the overlay will typically be fabricated smaller than the overlay. This allows for die cutting and assembly tolerances. All layers will typically be .015" inset from the overlay at all edges and cutouts.

Laser Cutting

The various layers of a membrane switch can be cut out by using a numerically controlled laser. This technology offers two advantages. Tighter mechanical tolerances can be held, and no tooling is required. While laser cutting is a more expensive process than die cutting, in many low and medium volume applications it is quite cost effective.

Pinouts

The schematic or pinout of a switch may be specified by the customer, but if it is initially unimportant to the customer, then the pinout should be unspecified. As with any circuit layout, more freedom will allow us to produce a more efficient layout. This has the advantage of shorter development time and a simpler circuit layout, which could nominally affect switch reliability. Membrane switches can be designed with a common bus or in a matrix. Matrix layouts are desirable for keyboards with many keys to simplify the interconnect.

ESD/RFI Shielding

Several options are available for shielding membrane switches. The most common are printed carbon, printed silver, and aluminum foil. From a functional standpoint, the main difference among these materials is their conductivity. Either carbon or silver can be printed on the top of the top circuit to act as a shield. These shields have the advantage of not adding any additional layers to the switch construction. Carbon shields are less expensive than silver shields. Silver is usually printed in a grid pattern to reduce cost. A layer of aluminum foil can also be added above the top circuit. This material is the most conductive shield available. However, it does add two layers to the switch construction. The shield is usually connected to the ground through the connector, or by means of a tab with a slot for a fastener. The customer should express their shielding requirements in Ohms per square inch. The entire product packaging must be

considered when specifying shielding requirements.

Tail Exit Point

Flexible membrane switches are connected by means of a flexible tail that is cut from the circuit material. We have a great deal of flexibility in selecting the exit point. The tail cannot exit under or within .125" of the active keypad area.

Interconnect

The flexible tail that exits a membrane switch usually has single row traces on .100" centers. This tail can be connected to a circuit board with many different single row connectors designed for flex circuits. Holland Nameplate is tooled to crimp AMP, Berg, and Molex connectors onto flex circuits.

The most common type of Berg connector used is the Berg Clincher (65801). This is a female single row connector with contacts on .100" centers. The Clincher system is also available in a male version, part number 66226. The AMP system is a two component system. The contacts are specified separately from the housing. The flex circuit can also be terminated with solder tabs that can be directly soldered onto the circuit board. The AMP part number used is 88997-2.

The lowest cost alternative is to use a ZIF (Zero Insertion Force) connector. AMP and Molex both offer ZIF connectors. When using a ZIF connector the membrane switch is shipped with exposed contacts on the end of the tail. The customer then inserts the tail into the ZIF connector. ZIF connectors are available with locking mechanisms in both .100" and .050" centers. When using a ZIF connector, you should specify either the connector or the requirements for the connector.

Screen Printed Flex Circuits

The typical flex circuits used in membrane switches are made with screen printed silver-filled epoxy ink. The process is carefully controlled to insure maximum conductivity, adhesion, and flexibility.

This type of circuit does not utilize feed thrus, so circuits are single sided. Traces can cross through use of a dielectric crossover. This increases the number of printing operations, and consequently increases cost. A dielectric material is screen printed in the area the trace will be crossed over, and then silver jumpers are printed on top of the dielectric.

Creasing of Flex Circuits

In many applications the tail of a membrane switch needs to be bent at or near the exit point. Extreme caution should be exercised when bending flex circuits. While it is likely that continuity will be maintained in a trace that is creased sharply, the trace will most likely be damaged, and be a potential area of future failures. It is recommended that a .010" radius be used to wrap the flex tail around if a bend needs to be put into the tail. A folded piece of card stock works well.

It is also possible to have Holland Nameplate form the tails with a bend to a customer's specification. This allows Holland Nameplate to inspect and test the parts after the bend is in the tail. Always inform Holland Nameplate's Engineering Department when a crease is going to be put into the tail of a membrane switch, so that this fact can be taken into consideration during design.

Rigid Membrane Switches

It is often desirable to build a membrane switch onto a rigid circuit board instead of using screen printed flex circuits. This construction provides a rigid panel, and allows for the easy addition of other components, such as LEDs and resistors. These types of membrane switches are usually supplied with a standard header with pins on .100" centers.

Domes

Because of the relatively short travel of membrane switches, it is often necessary to provide users with some type of feedback. Feedback can be visual, audible, or tactile. Visual or audible feedback should be a consideration in the electronics design.

Domes can be added to a membrane switch to provide tactile feedback. There are two types of domes that we use in membrane switches, stainless steel and polyester. There is no significant difference in reliability between these two dome technologies.

Many people prefer the feel of stainless steel domes. Stainless steel domes also require lower initial tooling costs. Stainless steel domes are almost always used on printed circuit board based membrane switches.

Polyester domes are usually formed into the top circuit of the membrane switch. Polyester domes require relatively expensive machined tools that are built specifically for each design.

As volumes increase, polyester domes become more cost effective because they do not need to be assembled individually. As a general rule of thumb, it makes economic

sense to consider polyester domes if the total dome usage per order is expected to exceed 2500. A drawback of polyester domes is that they tend to relax and lose their tactile feel at elevated temperatures and are not recommended for applications that will experience temperatures above 55˚C (131˚F).

Actuation Force

The customer may specify the switch actuation force. Typical actuation forces range from 6 to 24 ounces. Polyester domes usually have greater actuation force than do stainless steel domes. Polyester domes have typical actuation forces of 14 to 24 ounces, and stainless steel domes are in the 12 to 18 ounce range. The tolerance on actuation force is +/- 3 ounces.

Electrical Performance

The great variety of membrane switch designs makes it difficult to outline a general set of specifications that covers all membrane switches. Listed below are some basic performance specifications. If an application has specific requirements other than the ones below, the customer should be certain to communicate them to Holland Nameplate.

Loop Resistance
The loop resistance of a switch is a function of trace width and length. In almost all applications the maximum loop resistance is less than 100 Ohms.

Open Circuit Resistance
50 MegaOhms minimum

Contact Rating
100 Milliamps at 28 VDC Maximum

Maximum Load
1.5 VA Nominal

Contact Bounce
5 Milliseconds Nominal

Operating Temperature Range

-45˚C to + 75˚C (See notes on polyester domes)

Life Cycle Testing

Holland Nameplate performs life cycle testing to insure that our customers have a realistic expectation as to the typical number of cycles a particular design can endure. Any specific life requirements should be communicated to Holland Nameplate's engineering department before the design begins.

Windows

The overlay materials used in membrane switches begin the process clear. Colors are screen printed on the back of the overlay material. Areas that do not have color printed on them become windows.

As mentioned in the section on hardcoats, window areas can have a variety of hardcoats or textures added to them. It is recommended that small discrete LED annunciator windows have the same texture as the background. Larger windows for LEDs, LCDs, or VFDs may need a window with less light diffusing characteristics. Window coatings in general are a trade-off between anti-glare characteristics and optical clarity. The closer the display is to the overlay the less effect the coating will have on display readability.

If LED displays are within .062" of the overlay, a velvet texture will usually yield acceptable readability. For distances greater than .062", we recommend a matte finish for the window coating.

If LCD displays are within .125" of the overlay, an anti-glare coating should yield acceptable readability. For distances greater than .125" a gloss coating may be necessary.

Insertable Legends

In some applications it is desirable to have the ability to customize some of the legends, either when the switch is assembled to the end product or in the field. This allows a customer to use one standard membrane switch for many different models of similar instruments. It also allows customizing a membrane switch for specific applications.

Switches can also be designed with legend cards that can be changed by the end user. One very successful application is a scoreboard with an insertable legend card for each sport. This allows the user to re-legend the switch for the sport that is being played. Consequently, the switch can be kept relatively small with only a few keys.

To design a switch with insertable legends, a clear window is put into the area

that will have insertable legends. An oversized pocket is put behind this clear area so that the legend card can be inserted and seen through the window. The entire overlay has the same texture, which helps hide the fact that legends are being viewed through a window. The diffusing properties of the texture are not a problem for viewing the legends because the legend cards are held directly against the overlay by the pocket.

It is also recommended that the background color be different than the color surrounding the window. This will also help disguise the legend card. The fact that a membrane switch has insertable legends can be almost completely transparent to the user if implemented correctly.

Thick Film Resistors

Screen printed carbon thick film resistors can be incorporated into a membrane switch flex circuit. The tolerances of the resistors determine their cost. Tolerances of +/- 10% can be held if required. In most cases these are relatively expensive resistors.

Embedded LEDs

It is relatively common to include small surface mounted LEDs into membrane switches. This is a very simple way to add annunciators to a switch.

A standard membrane switch is not thick enough to accommodate the package size of most surface mounted LEDs. For this reason, the overlay may be embossed in the window area, or extra fillers may be added to the switch construction.

Silver conductive epoxies are used to mount the LEDs to the circuit. These epoxies are not very flexible, and consequently switches with embedded LEDs should not be bent in the LED areas prior to being installed. Stiffeners can be added to the switch construction to add rigidity when needed.

Data sheets and engineering samples for embedded LEDs are available from Holland Nameplate sales engineers.

Mounting Adhesives

In most cases flexible membrane switches are shipped to our customers with a pressure sensitive adhesive on the back side. The most commonly used adhesive is 3M's 467MP. This is an excellent adhesive for bonding to smooth metal and high surface energy plastic surfaces. For rougher surfaces we recommend 3M's 468MP. If you are uncertain as to the correct adhesive for your mounting surface, contact a Holland Nameplate sales engineer.

Always clean the surface before installing a membrane switch. If alignment is difficult, we recommend that you remove a small corner of the backing, align the membrane switch, stick the corner down, bend back the membrane switch and remove the rest of the liner. NEVER bend a membrane switch in an LED or dome area. After the membrane switch is correctly located, rub it down with firm pressure. The adhesives we use are called pressure sensitive adhesives because they need pressure to insure a strong bond. The adhesive will continue to cure for many days. It will have reached 90 percent of its ultimate bond within 72 hours under most conditions. No testing of the adhesive should be done within 72 hours of installation.

Subpanels

In some applications it is desirable to have Holland Nameplate supply the membrane switch mounted to a rigid subpanel. The most commonly used material for such subpanels is aluminum. These subpanels can be supplied with a variety of hardware installed.

It is important to keep in mind that the subpanel must have different mechanical dimensions to allow for assembly tolerances. The subpanel should be .020" smaller than the membrane switch in both height and width. All cutouts and holes should be .030" larger. Cutouts behind windows should be .060" larger than the window. These general guidelines are intended to help insure that the subpanel is not visible after assembly.

Backlighting

We offer several backlighting solutions for viewing legends in no light and low light applications. The most common backlighting methods used are fiber optics, electroluminescent panels, and LEDs. Fiber optics and electroluminescent panels offer the advantage of uniform light over a large area.

Drawings and Specifications

Our ability to manufacture a switch which meets our customer’s expectations is dependent on how well we understand our customer’s requirements. The customer should be sure to supply us with as much detail about his design requirements as possible. Appendix “B” is a checklist of issues that should be addressed in communicating a customer’s complete requirements. It is helpful for the customer to supply a copy of this checklist with notes on topics not covered elsewhere in this documentation. Additionally, there Is no substitute for a detailed engineering drawing

of the membrane switch. A sample of a simple drawing of a membrane switch is included in Appendix “C”. Appendix “D” is a glossary.

Holland Nameplate Overlay Material Guide
Appendix A

Product ID	Manufacturer	Base Film	Hardcoat	Finish	Embossable	UL Rating	Texturable	Thickness
Melinex 561	ICI	Polyester	No	Gloss	Yes	No Rating	Yes	.005" - .010"
Autotex2-V	Autotype	Polyester	Yes	Velvet	Yes	94-HB	Yes	.006" - .008"
Autotex2-V-W	Autotype	Polyester	Yes	Velvet	Yes	94-HB	Yes	.006" - .008"
Autoflex EBG	Autotype	Polyester	Yes	Gloss	Yes	94-VTM2	Yes	.005" - .010"
Autoflex EBA	Autotype	Polyester	Yes	Matte	Yes	94-VTM2	Yes	.005" - .010"
Marnot XL	Tekra	Polycarbonate	Yes	Various	Yes	94-V2	Yes	.007" - .030"
8010 Lexan	General Electric	Polycarbonate	No	Gloss	Yes	94-V2	Yes	.007" - .030"
8B35 Lexan	General Electric	Polycarbonate	No	Velvet	Yes	94-V2	Yes	.005" - .020"
HP-92 Lexan	General Electric	Polycarbonate	Yes	Gloss	No	94-V2	Yes	.007" - .030"
HP-40 Lexan	General Electric	Polycarbonate	Yes	Matte	No	94-V2	Yes	.007" - .030"
HP-12 Lexan	General Electric	Polycarbonate	Yes	Matte	No	94-V2	Yes	.007" - .030"
FR-60 Lexan	General Electric	Polycarbonate	Yes	Gloss	Yes	94-V0	No	.010" - .040"
FR-65 Lexan	General Electric	Polycarbonate	Yes	Velvet	Yes	94-V0	No	.010" - .020"
Makrofol EPC	Bayer	Tedlar	No	Velvet	Yes	No Rating	No	.007" - .030"

Holland Nameplate Membrane Switch
Checklist Appendix B

The following items need to be communicated to Holland Nameplate before an order can be processed.

___ Mechanical dimensions of the finished part

___ Tolerance specified (+/- .015")

Type of switch

___ Non Tactile

___ Tactile with stainless steel domes

___ Tactile with polyester domes

Tail details

___ Tail exit point

___ Tail length

Tail termination

___ Berg Clincher

___ AMP

___ Solder Tabs

___ Exposed silver for ZIF

___ Other _____

Pinout

___ Determined by Holland Nameplate

___ Customer Specified

Shielding

___ None required

___ Printed silver grid

___ Printed carbon

___ Aluminum foil

___ Other _____

Overlay Material

___ Velvet textured polycarbonate (8B35)

___ Gloss polycarbonate with hardcoats (8010)

___ Velvet textured polyester with hardcoat (Autotype)

___ Gloss polyester with hardcoats (Autoflex)

___ Other _____

Logos and special graphics

___ Customer supplied

___ None required

Windows/Lens coating

___ Velvet textured (enunciator, LED)

___ Anti Glare (LED, VF, LCD)

___ Gloss, water clear (LCD)

___ Window insert

Embossing

___ Key rims

___ Plateau

___ LED windows

Hydroforming

___ Key rims

___ Plateau

___ LED windows

Insertable legends

___ Not required

___ Specified

Support panel

___ LED windows

___ Not required

___ Drawing included with material specified

Artwork

___ Holland Nameplate generated

___ Customer supplied (attached to order)

___ Colors specified

Color matching

___ Custom (samples supplied)

___ Pantone Matching System

___ Federal Standard No. 595a

___ Copy size, style, and location specified

Switch Sealing Requirements

___ Standard splash resistant

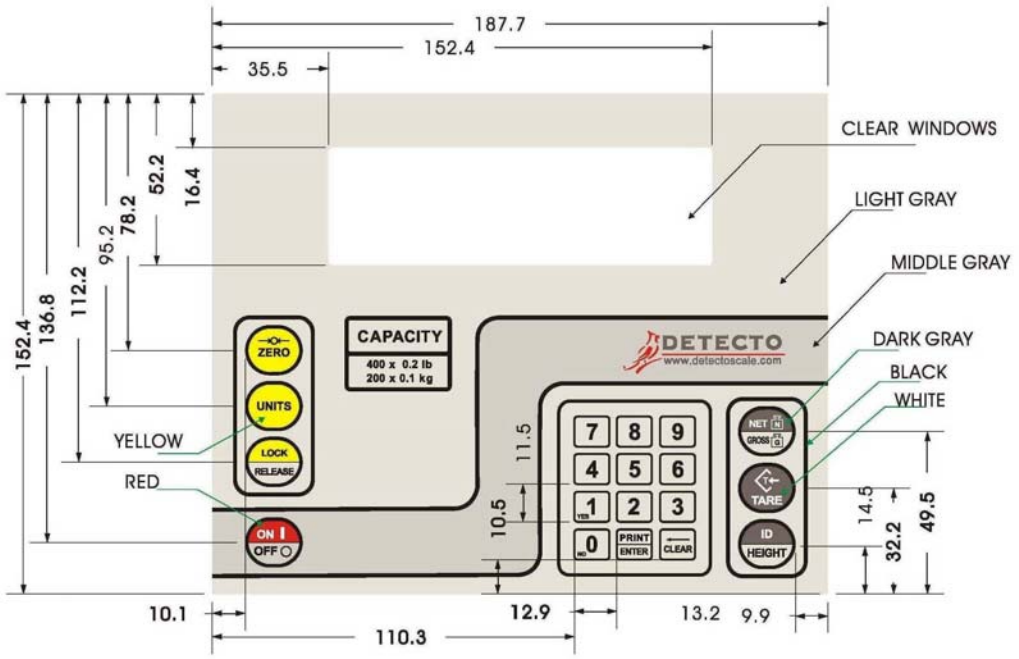
___ NEMA 4

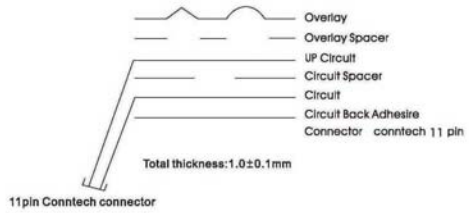
Switch Venting Requirements

___ Standard internal venting

___ Externally vented

Membrane Sample Appendix C





Note: All the colors according to the customer sample

STANDARD TOLERANCE LIMITS UNLESS OTHER SPECIFIED.		
RANGE	TOLERANCE ✓	
>0~40	±0.2MM	±0.08
>40~100	±0.2MM	±0.12
>100~150	±0.2MM	±0.18
>150~300	±0.2MM	±0.25

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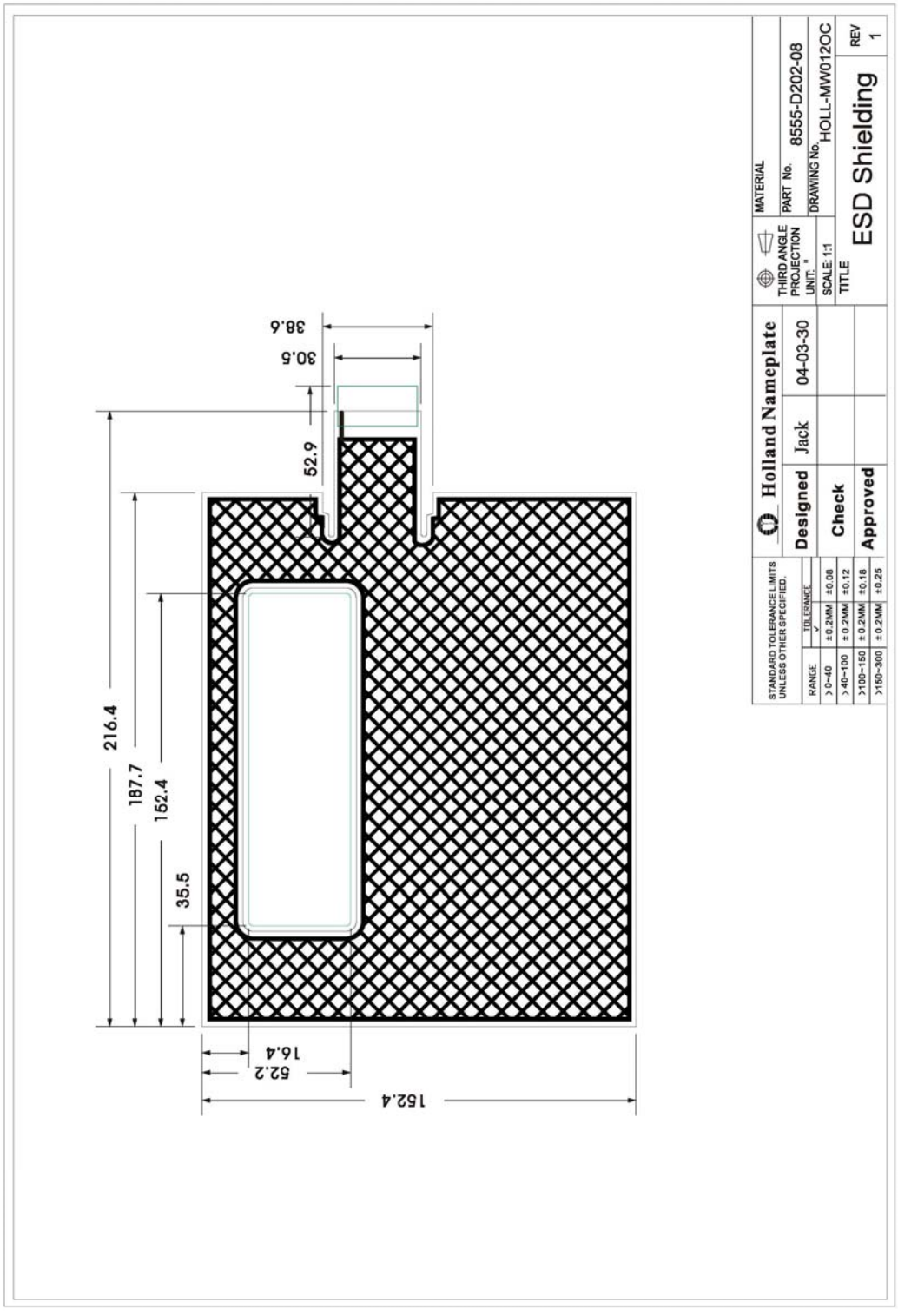
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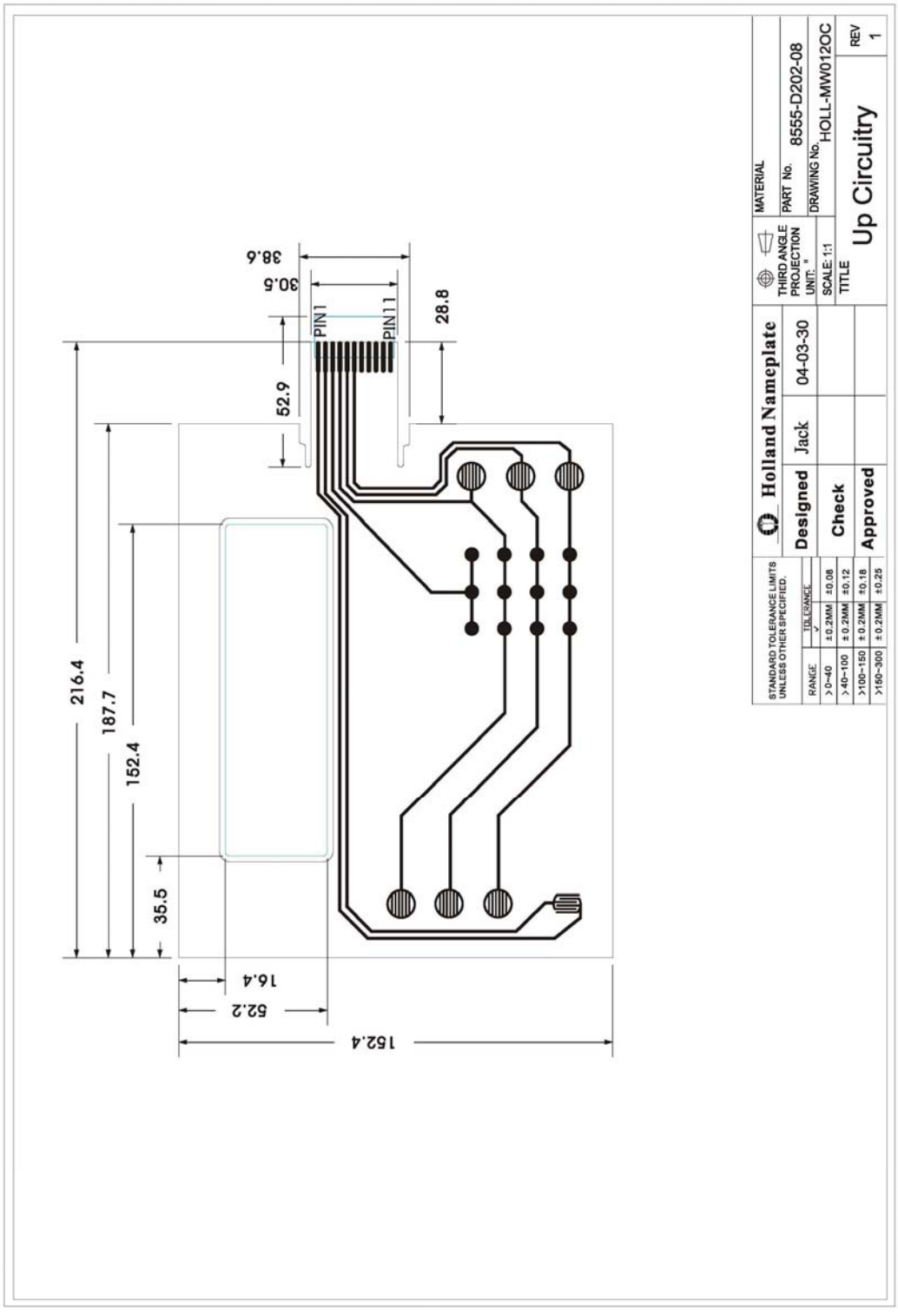
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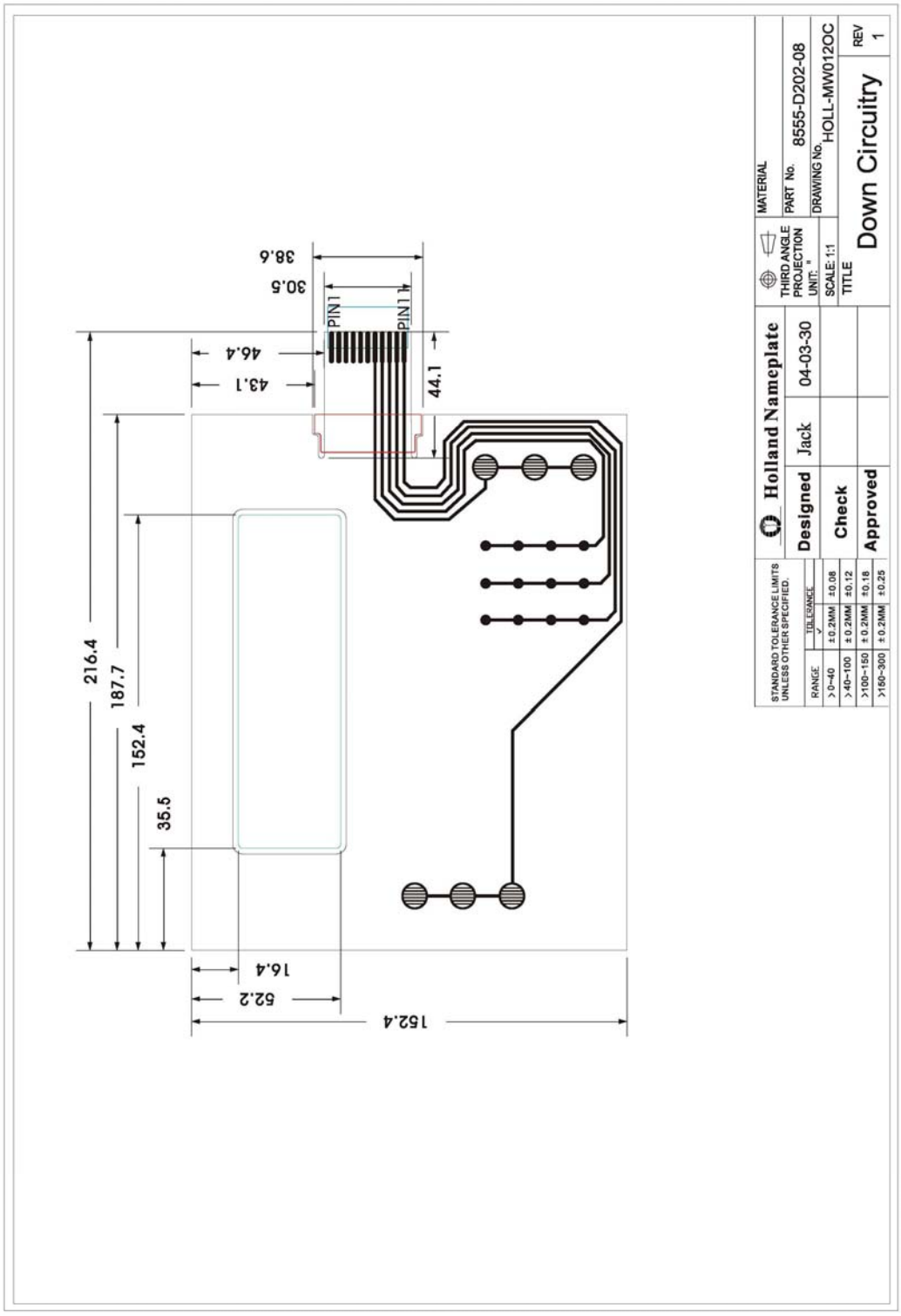
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Glossary
Appendix D

Actuation Force- The maximum force measured prior to or including the point at which keypad contact closure is achieved.

Alodine- A chemical conversion process that oxidizes aluminum to form a non-porous aluminum oxide. Referred to as “poor-man’s anodizing” because it is less costly and not as durable as anodizing.

Anodize- Electro-chemical oxidation of aluminum to form aluminum oxide with a porous nature. The anodized layer can be durably colored and is non-conductive, non-corrosive and resistant to abrasion.

Arcing- Discharge of electricity (a spark) that can occur when contacts are opened or closed. Arcing can degrade or burn contacts, reducing useful life.

Backlighting- A flexible layer within a membrane switch construction that illuminates select areas of the overlay, such as text or graphic symbols. Examples of backlighting methods are E.L. (electroluminescent) or fiber optic.

Circuit- Functioning component (sub-layer) of a membrane switch. Typically made of a silver conductive ink printed on polyester. Also can be a flexible copper circuit, a PCB or polyester printed with other conductive materials.

Contact Bounce- (Make) – Point at which specified resistance is achieved.

Dead Front- Printing translucent ink in an area so that the graphic is visible only when backlit.

Density- The degree to which light transmits through a color or transparent window. The higher the density, the less light will be transmitted.

Dielectric Strength- The voltage that an insulating material can withstand before breakdown occurs, usually expressed as a voltage gradient (such as volts per mil.)

E.M.I. (also R.F.I)- Electromagnetic Interference (Radio Frequency Interference.) Radiated energy from electrical devices, lightning and similar sources which interferes with the proper operation of electronic circuitry.

E.S.D.- Electrostatic Discharge – transfer of high potential electrical charge between objects by contact or through air.

Files- Information or documentation created electronically by computer.

Font- A set of characters having a unified design.

Gloss Level- The degree of shininess of a particular material, usually specified in percentages such as 75% gloss, 90% gloss, and so forth.

Halftone- Image made of a pattern of various size and shape dots (newspaper photograph) rather than continuous gray.

Image-Setting- The process by which electronic files are transferred to film or paper directly from the computer (computer onto film technology.)

L.E.D.- Light Emitting Diode.

Membrane Switch- A momentary switching device in which at least one contact is made of a flexible substrate.

Moisture Resistance- Ability of a material to repel moisture either from air or when subjected to water.

Non-Tactile Switch- A switch assembly that has a tactile ratio equal to zero.

Overlay- Top layer of a membrane switch (the graphic interface between device and user) generally made of polyester or polycarbonate.

Pad Emboss- A raised area on an overlay, which defines an entire graphic. (i.e., a full keypad of L.E.D. window.)

Proof- A paper simulation of what a screen printed overlay will look like, submitted to a customer for approval.

Polyester Dome- A keypad on a membrane that has been dome-embossed on the overlay or top circuit layer to add tactile feedback when the switch is activated. The dome shape, which is usually formed by a hydro-forming process, can vary in size and shape to achieve a desired "force" and "tactile feedback" of the keypad.

Prototype Tooling- Method of fabricating prototype components without using steel rule dies (hard tooling) allowing changes before production runs without expensive tooling charges.

Rail Emboss- A raised area on an overlay which defines the perimeter of a graphic. (i.e., perimeter of a keypad or a border.)

Schematic- A drawing showing electrical interconnections and functions of a specific circuit arrangement.

Screen Printing- Method of printing by forcing ink through a mesh selectively. This is done by closing parts of the mesh with a stencil.

Screen Tint- Area of image printed with dots so ink coverage is less than 100%, simulating shading or a lighter color.

Selective Texture- A transparent velvet finish printed on specified areas on an overlay to accentuate design elements such as windows, keypads or graphics.

Shield- A layer of polyester material that is either laminated with aluminum or printed with conductive ink to protect a switch from E.S.D. or E.M.I. interference.

S.M.D.- Surface Mount Device.

S.M.T.- Surface Mount Technology.

Specified Resistance- Maximum allowable resistance measured between two terminations whose internal switch contacts, when held closed, complete a circuit.

Sub-Surface Printing- Imaging on the back (second surface) of an overlay so the printed graphic is protected from wear by the actual material.

Tactile Ratio- A measure of tactile response.

Tactile Response- A sudden collapse or snapback of a membrane switch prior to contact closure or after contact opening.

Tactile Switch- A switch assembly that provides a tactile ratio greater than zero. Tactile switches give the user immediate physical feedback that the switch has been activated. Tactile feedback on a membrane switch can be achieved by using a stainless steel dome or a polydome construction.

Termination- How a switch is connected to the device it activates.

Translucent- Partially transparent. Having the property of diffusing light.

Transparent- Having the property of transmitting light without appreciable scattering so that objects beneath are entirely visible.